



## CAMERA SYSTEM AND LENS BARREL

### INCORPORATION BY REFERENCE

The disclosure of the following priority application  
5 is herein incorporated by reference:

Japanese Patent Application No. 2002-199430 filed July 9, 2002

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

10 The present invention relates to a lens barrel and a camera system that employs the lens barrel.

#### 2. Description of the Related Art

A camera system includes various types of operating switches such as a shutter speed setting dial, an autofocus start button and a focus lock button. As the number of  
15 operating switches increases to support multiple functions in the camera system, a problem arises in that the increasingly complicated operations the operator is required to perform to switch the various functions on and off become a hindrance  
20 to the full utilization of the functions that camera system offers.

### SUMMARY OF THE INVENTION

The present invention is to provide a camera system and  
25 a lens barrel allowing an operator to photograph with ease.

A camera system according to the present invention comprises: a camera body; a lens barrel having a photographing optical system, which can be mounted at the camera body; a shutter release switch disposed at the camera body and operated to start a shutter release operation; and a first operating switch related to an operation of the camera system other than the shutter release operation. The first operating switch is disposed at the lens barrel so as to allow an operator to perform a batch operation of the shutter release switch and the first operating switch with the lens barrel mounted at the camera body.

It is preferable that a camera system has at least: a) an autofocus function for achieving a focus state in the photographing optical system, b) a go-home function for storing in memory a focus position of the photographing optical system corresponding to a predetermined photographing distance as a target focus position and adjusting the photographing optical system to the target focus position and c) a vibration correction function for correcting an image blur, and that the first operating switch is used to issue an operational instruction for one of; a) the autofocus function, b) the go-home function and c) the vibration correction function in the camera system.

It is preferable that the lens barrel further comprises a focus ring with which the focus-match state is manually

achieved in the photographing optical system and at least one  
second operating switch disposed along the focus ring; and  
that the first operating switch is disposed so as to allow  
the operator to operate the first operating switch with his  
5 hand with which the shutter release switch is operated; and  
the second operating switch is disposed so as to allow the  
operator to operate the second operating switch with his hand  
with which the focus ring is operated. It is preferable that  
the second operating switch is used to issue an operational  
10 instruction for one of; a) the autofocus function, b) the  
go-home function and c) the vibration correction function in  
the camera system.

A lens barrel that can be mounted at a camera body  
according to the present invention comprises: a photographing  
15 optical system; and a first operating switch with which an  
operational instruction for the photographing optical system  
is issued, and wherein the first operating switch is disposed  
so as to allow an operator to perform a batch operation of  
a shutter release switch at the camera body and the first  
20 operating switch with the lens barrel mounted at the camera  
body.

It is preferable that the first operating switch is used  
to issue an operational instruction for at least one of; a)  
an autofocus function for achieving a focus state in the  
25 photographing optical system, b) a go-home function for storing

in memory a focus position of the photographing optical system corresponding to a predetermined photographing distance as a target focus position and adjusting the photographing optical system to the target focus position and c) a vibration  
5 correction function for correcting an image blur by moving at least one lens constituting part of the photographing optical system along a direction intersecting an optical axis of the photographing optical system. A lens barrel may further comprise: a focus ring with which the focus state is  
10 manually achieved in the photographing optical system; and at least one second operating switch disposed along the focus ring. It is preferable that the second operating switch is used to issue an operational instruction for at least one of;  
a) the autofocus function, b) the go-home function and c) the  
15 vibration correction function.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the camera system achieved in an embodiment of the present invention; and

20 FIG. 2 schematically shows the structure adopted in the camera system in the embodiment.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

The following is an explanation of an embodiment of the  
25 present invention, given in reference to the drawings.

FIG. 1 is a side view of the camera system achieved in an embodiment of the present invention and FIG. 2 schematically shows the structure adopted in the camera system.

As shown in FIGS. 1 and 2, the camera system includes  
5 an interchangeable lens (lens barrel) 1 and a camera body 3. The interchangeable lens 1 includes a first operating switch 2, second operating switches 4, a focus ring 5 with which a manual focusing operation is performed and a tripod mount 6 used to lock the interchangeable lens 1 to a tripod.

10 The first operating switch 2 is disposed at the interchangeable lens 1 so that it is set in the vicinity of a shutter release switch 33 provided at the camera body 3 when the interchangeable lens 1 is mounted at the camera body 3. Namely, it is disposed so as to allow the operator to operate  
15 the shutter release switch 33 and the first operating switch 2 together when the interchangeable lens 1 is mounted at the camera body 3. In this document, such simultaneous operations of the shutter release switch 33 and the first operating switch 2 by the operator is referred to as a batch operation. The  
20 first operating switch 2 is a switch operated when using a go-home function which is to be detailed later.

Four second operating switches 4 are provided over approximately 90-degree intervals along the circumferential direction near the focus ring 5. Through the second operating  
25 switches 4, an operational instruction for one of the functions

available in the camera system, i.e., the go-home function, an autofocus function and a vibration correction function, can be issued. For instance, by operating a second operating switch 4 an instruction to effect a go-home start for go-home control, to start autofocus control, to effect a focus lock in the autofocus control or to start vibration correction control can be issued. The specific operational instruction to be issued through the second operating switches 4 can be selected with a function selector switch 7 shown in FIG. 2.

10 As shown in FIG. 2, the camera body 3 includes a CPU 31, a CCD 32, a focus detection unit 34 and a viewfinder 35. The CPU 31, which is connected with a CPU 21 at the interchangeable lens 1 via a coupler 9, implements overall control for the camera system including the autofocus control and the vibration correction control. The CCD 32 captures  
15 a subject image having passed through a photographing optical system in the interchangeable lens 1. The focus detection unit 34 detects the focus state of the captured image and outputs a focal point detection signal to the CPU 31.

20 The interchangeable lens 1 includes a first lens group 11, a second lens group 12, a third lens group 13 and a fourth lens group 14. The first lens group 11, the second lens group 12, the third lens group 13 and the fourth lens group 14 together constitute the photographing optical system. The second lens  
25 group 12 performs focusing as it moves along an optical axis

L. The fourth lens group 14 corrects an image blur caused by hand movements as it moves within a plane perpendicular to the optical axis L.

In addition, the interchangeable lens 1 includes the function selector switch 7, the coupler 9, the CPU 21, a magnetic encoder 22, an ultrasonic motor 23, an autofocus (AF) control unit 24, a vibration correction drive unit 25, a vibration sensor 26 and the like. The function selector switch 7 is used to select a specific function through a second operating switch 4 as described earlier. The coupler 9 electrically connects the CPU 21 at the interchangeable lens 1 with the CPU 31 at the camera body 3. The magnetic encoder 22 detects the position of the second lens group 12. The vibration sensor 26 detects a vibration of the interchangeable lens 1 caused by hand movement, i.e., the displacement of the interchangeable lens 1 relative to an absolute space.

The CPU 21 of the interchangeable lens 1 assigns an operational instruction for the function selected with the function selector switch 7 to the second operating switches 4 in response to a signal provided from the function selector switch 7. An operational instruction signal from the second operating switch 4 and an operational instruction signal from the first operating switch 2 are input to the CPU 21. The CPU 21 executes the autofocus control and the go-home control to be detailed later by controlling the AF control unit 24.

The CPU 21 also executes the vibration correction control by controlling the vibration correction drive unit 25 in response to a detection signal provided by the vibration sensor 26.

5       The AF control unit 24 controls the ultrasonic motor 23 based upon a command issued by the CPU 21. The ultrasonic motor 23 executes focus control by driving the second lens group 12 along the optical axis L in response to a command issued by the AF control unit 24.

10       The vibration correction drive unit 25 corrects an image blur caused by hand movement by driving the fourth lens group 14 along a direction perpendicular to the optical axis L in response to a command issued by the CPU 21.

Next, the go-home function of the camera system is explained.

15       The go-home function refers to a function through which the focus position of the photographing optical system corresponding to a given photographing distance is stored in memory in advance as a target focus position and the photographing optical system is adjusted to the target focus position whenever desired. More specifically, the second lens 12 is driven to focus on a subject positioned at a desired photographing distance and this focus state is stored into a memory (not shown) (a focus preset is performed). Then, as a go-home start switch is operated while the focus is adjusted  
25   to another subject, the second lens group 12 is driven so as



to achieve the stored focus state instantly.

The go-home function can be effectively utilized when photographing, for instance, a sporting event. For instance, the function can be used to advantage when photographing a  
5 baseball player running toward the third base for a steal during a baseball game. Since the steal motion occurs rapidly and the player is already running, the autofocus control may not work effectively in the camera system. Accordingly, the focus is preset at third base in advance by using the go-home  
10 function. As the photographer photographing the player at bat or the pitcher operates the go-home start switch as soon as he becomes aware of the steal play, the focus is adjusted to the third base instantaneously. Thus, he does not miss photographing the steal play.

15 Next, an operation executed in the camera system in the embodiment of the present invention is explained. It is assumed that the go-home function has been selected with the function selector switch 7 and the second operating switches 4 have been assigned to function as the go-home start switch  
20 for starting the go-home function in the embodiment. In addition, the first operating switch 2 is used to preset the focus for the go-home function. In the following explanation, the procedural steps of the operation performed by the operator using the go-home function are described in correspondence  
25 to the operation executed in the camera system.

First, the photographer presses the shutter release switch 33 (see FIG. 1) halfway down with the index finger of his right hand with the focusing zone of the focal adjustment area adjusted to a subject present over a desired photographing distance, e.g., the third base. In response to the halfway press operation of the shutter release switch 33, the CPU 31 at the camera body 3 calculates the defocus quantity based upon a range finding signal provided by the focus-match detection unit 34. The CPU 31 provides a defocus signal corresponding to the defocus quantity thus calculated to the CPU 21 at the interchangeable lens 1. Based upon the defocus signal provided by the CPU 31, the CPU 21 provides a control signal to the AF control unit 24.

Based upon the control signal from the CPU 21, the AF control unit 24 drives the ultrasonic motor 23, thereby executing the focus control by moving the second lens group 12 along the optical axis L. The magnetic encoder 22 detects the position of the second lens group 12 and provides position data indicating the detected position to the CPU 21 via the AF control unit 24.

The focus detection unit 34 checks whether or not the focus control by the AF control unit 24 has been completed. As it is verified the focus state has been achieved, a display is brought up on a liquid crystal display (not shown) inside the viewfinder 35 to indicate that the focus state has been

achieved.

When pre-setting the focus for the go-home function, the photographer presses the shutter release switch 33 halfway down and operates the first operating switch 2 with the middle  
5 finger of his right hand while focusing on the desired subject. In response to the operation of the first operating switch 2, the position information indicating the position of the second lens group 12 detected by the magnetic encoder 22 is stored into the memory inside the interchangeable lens 1 as  
10 a go-home target (a target focus position). The focus preset is thus completed. Once the focus preset is completed, a buzzer (not shown) provided at the interchangeable lens 1 sounds to inform the photographer of the focus preset completion. After the focus preset is completed, the go-home  
15 target is maintained even if the operation of the first operating switch 2 stops, until another focus preset operation is performed.

In addition, in response to the halfway press operation of the shutter release switch 33, the CPU 31 at the camera  
20 body 3 issues an instruction for the CPU 21 of the interchangeable lens 1 to start the vibration correction control. Upon receiving the instruction for the vibration correction control start, the CPU 21 determines the extent to which the fourth lens group 14 is to be driven based upon  
25 vibration information provided by the vibration sensor 26.

Then, the CPU 21 outputs the drive quantity calculated for the fourth lens group 14 to the vibration correction drive unit 25. The vibration correction drive unit 25, in turn, drives the fourth lens group 14 so as to achieve the drive quantity indicated by the CPU 21. By moving the fourth lens group 14 within a plane perpendicular to the optical axis L and thus shifting the optical axis L of the photographing optical system, a blurring of the photographic image captured by the CCD 32 is corrected. The vibration correction control is executed each time the shutter release switch 33 is pressed halfway down.

After the autofocus control and the vibration correction control are executed in response to the halfway press operation of the shutter release switch 33, the photographer performs a photographing operation as in the related art by pressing the shutter release switch 33 all the way down.

In order to enter the focus state achieving the preset focus from a state other than the preset focus state, i.e., in order to focus on the subject present at the desired photographing distance, the photographer operates a second operating switch 4 with his left hand while holding the camera body 3 with his right hand. In response to the operation of the second operating switch 4, the CPU 21 determines a control signal based upon the difference between the current position of the second lens group 12 detected by the magnetic encoder

22 and the go-home target stored in memory and provides this control signal to the AF control unit 24. The AF control unit 24 drives the ultrasonic motor 23 based upon the control signal from the CPU 21. As a result, the second lens group 12 is caused to move along the optical axis L and the camera system enters the focus-match state achieving the preset focus. Subsequently, the operator photographs the desired subject by pressing the shutter release switch 33 all the way down.

As described above, the photographer operates the shutter release switch 33 with the index finger of his right hand and operates the first operating switch 2 to perform a focus preset with the middle finger of his right hand. In other words, the photographer is allowed to perform both the shutter release operation and the focus preset operation with his right hand alone. Thus, he can preset the focus with a high degree of reliability at the photographing distance of the target subject without having to move the camera from one hand to the other. It is to be noted that the photographer may first achieve a desired focus state by operating the focus ring 5 with his left hand and then may perform a focus preset by operating the first operating switch 2 with his right hand. In this case, the photographer may start the go-home control by subsequently operating a second operating switch 4 with his left hand, with which he has operated the focus ring 5. The plurality of second operating switches 4 are provided along

the focus ring 5. Thus, the photographer is afforded ease of use since he can operate one of the plurality of second operating switches 4 with his left hand, with which he can also operate the focus ring 5.

5        It is to be noted that since the plurality of second operating switches 4 are provided along the focus ring 5 as described above, the photographer is able to operate one of the second operating switches 4 readily to start using the go-home function regardless of whether he is taking a  
10       photograph with a longitudinal composition by holding the camera body 3 in the portrait orientation or he is taking a photograph with a lateral composition by holding the camera body 3 in the landscape orientation.

      The first operating switch 2 is disposed at a position  
15       near the shutter release switch 33 so as to allow the photographer to operate it in a batch together with the shutter release switch 33. Thus, the photographer can perform a focus preset quickly by operating the first operating switch 2, regardless of whether he is taking a photograph with a  
20       longitudinal composition or a lateral composition. It is to be noted that in a camera system having a separate shutter release switch 33 for photographing pictures with a longitudinal composition, another first operating switch 2 may be provided in the vicinity of the shutter release switch  
25       33 for photographing pictures with a longitudinal composition

as well. In addition, as long as the first operating switch 2 is provided near the shutter release switch 33 and thus can be operated while operating the shutter release switch 33, the first operating switch 2 may be disposed at the camera body 3 instead.

While an explanation is given above in reference to the embodiment on an example in which the go-home function is selected with the function selector switch 7 and the function of instructing a go-home function start is assigned to the second operating switch 4, the present invention is not limited to this example. For instance, the camera system may be set up so as to start the autofocus control or the vibration correction control by operating a second operating switch 4 instead.

Furthermore, while a focus preset for the go-home function is executed in response to an operation of the first operating switch 2 in the embodiment described above, the present invention is not limited to this example. For instance, the camera system may instead be set up so as to start the vibration correction control or to effect a focus lock in the autofocus control by operating the first operating switch 2. In such a case, too, the operator is allowed to select the function to be assigned to the first operating switch 2 by operating the function selector switch 7. As the function selector switch 7 is operated, the CPU 21 sets the selected

function at the first operating switch 2. Namely, the functions to be assigned to the first operating switch 2 and the second operating switches 4 can be individually set with the function selector switch 7.

5        For instance, the operator can set the first operating switch 2 to function as a focus lock switch in the autofocus control and the second operating switches 4 as a start switch for the autofocus control, by operating the function selector switch 7. In this case, the photographer starts the autofocus  
10 control by operating a second operating switch 4 with his left hand and locks the second lens group 12 in the desired focus state by operating the first operating switch 2 with his right hand. Since he can operate the first operating switch 2 while holding the camera body 3 with his right hand as in the embodiment  
15 explained above, ease of use is afforded.

In the embodiment described above, only one focus state achieving a preset focus, i.e., only one go-home target, is set in conjunction with the go-home function. However, the present invention is not limited to this example, and a  
20 plurality of focus states may be set as go-home targets instead. In such a case, it is desirable to allocate the different go-home targets each to one of the plurality of second operating switches 4 provided at the interchangeable lens 1.

While the ultrasonic motor 23 is utilized to drive the  
25 second lens group 12 in the autofocus control in the embodiment



described above, a DC motor may be used instead of the ultrasonic motor 23. In addition, the motor used in the autofocus control may be disposed inside the camera body 3. In such a case, the autofocus control motor inside the camera body 3 and the  
5 AF drive mechanism inside the interchangeable lens 1 should be connected with each other via a coupling mechanism of the known art.

Furthermore, while the position of the second lens group 12 is detected with the magnetic encoder 22 in the embodiment,  
10 an optical encoder or an electrical position detection device that uses a conductive pattern and a brush may instead be employed.

While an explanation is given above in reference to the embodiment on an example in which the present invention is  
15 adopted in an electronic camera that captures a subject image with the CCD 32, the present invention may also be adopted in a similar manner in a silver halide camera. While an explanation is given above in reference to the embodiment on an example in which the interchangeable lens 1 with a long  
20 focal length having the tripod mount 6 is used, the present invention may also be adopted in conjunction with an interchangeable lens 1 with a short focal length that does not include a tripod seat.

While four second operating switches 4 are provided along  
25 the focus ring 5 in the embodiment described above, the present

invention is not limited to this example. For instance, only one second operating switch 4 may be provided near the focus ring 5, or eight second operating switches may be provided along the circumference of the interchangeable lens 1.

5 While an explanation is given above in reference to the embodiment on an example in which the camera system has the autofocus function, the go-home function and the vibration correction function, the present invention is not limited to this example and it may be adopted in a camera system having  
10 at least one of the functions listed above. In addition, the camera system may have another function in addition to those listed above, as long as the first operating switch 2 and the second operating switches 4 can each be set to issue an operational instruction for one of the functions available  
15 in the camera system. Moreover, while an image blur caused by hand movement is corrected by moving the fourth lens group 14 within the plane perpendicular to the optical axis L, such an image blur may instead be corrected through image processing executed on the image captured at the CCD 32.

20 The above described embodiment is an example and various modifications can be made without departing from the spirit and scope of the invention.